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ORIGINAL ARTICLE

Meconium Amniotic Fluid is Associated with Endomyometritis

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Abstract

Purpose This study aimed to determine whether MSAF is associated with endometritis after delivery.

Methods This cohort study was conducted from 2012 to 2013 in Kosar Hospital of Qazvin, Iran. All women with cesarean delivery (1239 women) beyond 37 weeks of gestational age participated in the study. Data were collected on rates of endomyometritis, quality of amniotic fluid and were analyzed with bivariate and multivariate statistics. Probability values of $<.05$ were considered statistically significant.

Results We found that among 1239 women with cesarean delivery at term 2.34 % were diagnosed with endometritis. Compared with deliveries with clear amniotic fluid, those

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with MSAF had higher rates of endomyometritis (1.5 vs 3.2 %, $P < .04$).

Conclusion We found that the presence of MSAF is associated with puerperal infection even when being controlled for confounders.

Keywords Meconium · Amniotic fluid · Puerperal infection · Endomyometritis

Introduction

Meconium-stained amniotic fluid (MSAF), as a result of the passage of fetal colonic contents into the amniotic cavity, occurs in 15–20 % of term, and up to 40 % of post-term pregnancies [1]. The incidence of MSAF is less than 5 % in preterm pregnancies [2].

MSAF may act directly and indirectly on exposed tissue. Its effects depend on the concentration of meconium, duration of exposure, and the presence of associated stress factors (hypoxia, infection). MSAF has been linked with an increased risk of developing chorioamnionitis endometritis and higher rate of cesarean section and is associated with adverse fetal outcomes including meconium aspiration syndrome (MAS), admission to neonatal intensive care unit (NICU), neonatal sepsis, cerebral palsy, seizure, and pulmonary diseases [2–5]. Meconium aspiration syndrome is the most serious of these complications and has been reported in approximately 5 % of pregnancies complicated by meconium, with a resultant mortality rate of approximately 5–10 % [6, 7].

The main theories of meconium passage into amniotic fluid are physiological fetal gastrointestinal maturity or, alternatively, a pathological process due to fetal stress such as hypoxia or infection [7]. Although meconium appears very early in the gastrointestinal tract, MSAF rarely occurs before 34 weeks of gestation. Motilin, an intestinal polypeptide which stimulates contraction of intestinal muscle, is found in higher concentrations in post-term than preterm fetal gastrointestinal tracts. Furthermore, intestinal parasympathetic innervation and myelination also increase in later gestations, implying that the increasing incidence may reflect the maturation of peristalsis in the fetal intestine. Therefore, at increasing gestations, particularly post-term, MSAF may be a physiological event, reflecting the maturation of fetal intestinal function. MASF has also been attributed to stress secondary to hypoxia and infection. Passage of meconium occurs more frequently when umbilical vein oxygen saturations are below 30 % [8].

Several mechanisms have been proposed for meconium-associated puerperal infections, which include alteration in the antibacterial properties of amniotic fluid and enhanced bacterial growth [8, 9]. The importance of a possible association between meconium and puerperal infection is underscored by the various complications with which intrapartum and postpartum infections are associated. Chorioamnionitis affects .5–2.0 % of pregnancies [8, 10]. Chorioamnionitis is also more likely to occur when MSAF is present [11]. Maternal infection is also more likely in the presence of MSAF. Patients with MSAF were almost two and a half times as likely to develop postoperative endometritis [12].

Puerperal infection rates which are associated with the degree of meconium staining increase with rates rising as meconium thickness [8]. Meconium may enhance the growth of bacteria in amniotic fluid by serving as a growth factor, inhibiting bacteriostatic properties of amniotic fluid, or antagonising host defense systems, thus increasing the risk of chorioamnionitis [13]. Mechanisms of meconium-associated puerperal infections including altering the antibacterial properties of amniotic fluid and enhancing bacterial growth impair the host immune response through the inhibition of phagocytosis and neutrophil oxidative burst [14].

Only one study used multiple logistic regression analyses to show statistically significant associations between MSAF and both puerperal infections in term deliveries [12]. Most of these studies had fewer than 1000 patients and did not use multivariate analyses to control for confounding. Based on the high prevalence of meconium passage in pregnant women who admitted to Kosar hospital and controversial result studies on the relationship between puerperal infection and MSAF [15, 16], the current study aimed to determine whether MSAF is associated with endometritis.

Materials and Methods

This cohort study was conducted from 2012 to 2013 in Kosar Hospital of Qazvin, Iran. All women with cesarean deliveries (1239 women) beyond 37 weeks of gestational age participated in the study. Patients were divided into two groups: 619 women with MSAF and 620 with clear amniotic fluid. Cesarean section was performed in both groups based on obstetric indications. It should be mentioned that as cesarean delivery is a risk factor for puerperal infection, we selected the patients with cesarean methods in order to match the two groups.

Both groups received prophylactic antibiotic which contains 2 g of cefazolin immediately after giving birth, and three doses as a post-surgery medicine.

The inclusion criteria were as follows: (1) women with a single fetus; (2) cephalic presentation; (3) gestational age of $\geq$37 weeks; and (4) birth weight $\geq$2500 g;

The exclusion criteria were as follows: (1) high-risk pregnancy; (2) time of rupture of membranes $\geq$18 h; (3) dead fetus in utero; (4) fetal anomaly; (5) maternal medical diseases (including cardiovascular disease, renal disease,

anemic pregnant women,…); (6) BMI > 26; (7) cesarean duration >90 min; and (8) prophylactic antibiotic given before, during, and after delivery.

Pregnant women without MSAF were categorized as clear amniotic fluid.

Puerperal infection is referred to any bacterial infection of the genital tract after delivery that outbreaks with fever of 38 degrees Celsius or higher (100.4 °F) beginning after 24 h to 10 days from child birth and continues for at least 48 h. The degree was determined by measuring the fever through mouth four times a day.

Endometritis was defined when the body temperature was >38 °C, plus uterine tenderness, foul smell lochia, or white blood cell count more than 15,000/mm^3 dm.

Data collection was done through observation and physical examination and laboratory findings such as CBC diff, U/A, U/C. Maternal demographic data, route, and outcome of delivery were abstracted from the medical records by a single investigator using standardized definition. This present research was approved by the Ethics Committee, Qazvin University Medical Department.

Statistical Analysis

Univariate analyses of the predictor variables (clear amniotic fluid and MSAF) were performed for the dependent variables of postpartum endomyometritis. Mean ± standard deviation (SD) and frequency (%) were used to describe the patient characteristics. Student's *t* test was performed to assess the difference between two means. Chi-square test was used to compare categorical variables. Univariate and multivariate analyses of risk factors (odds ratio) associated with quality of MSAF and maternal factors were analyzed with 95 % confidence interval (95 % CI). Probability values <.05 were considered statistically significant.

Results

Out of a total of 1239 women who were studied, 620 patients were in the control group with clear amniotic fluid and 619 women were in case group with MSAF. Table 1 shows the demographics and perinatal outcomes (age, women education, gestational age, parity, duration of rupture of membrane, birth weight, Apgar score with mean and standard deviation) of patients with clear amniotic fluid in comparison with those with MSAF. Statistically significant differences between the two groups included percent of gestational age ($P = .001$), birth weight ($P = .01$), and Apgar score ($P = .04$).

Table 2 shows the puerperal infection rates were in two groups. The overall endomyometritis rate was 4.7 %. Patients with clear amniotic fluid had a 1.5 % endomyometritis rate; patients with MSAF had an overall rate of 3.2 % ($P = .04$).

Table 1 Maternal demographics and perinatal outcomes

	MSAF ($n = 619$)	Clear fluid ($n = 620$)	*P* value
Maternal age <35 years	24.47 ± 2.86	24.7 ± 1.84	.354
Education			
Under diploma	356 (57.2 %)	360 (58.2 %)	.31
Diploma	218 (35.3 %)	212 (33.1 %)	
University	45 (7.3 %)	48 (8 %)	
Parity			
G1	524 (84.7 %)	542 (78.8 %)	.116
MG	95 (15.3 %)	75 (12.2 %)	
Duration of ROM (h)			
≥18	1 (.017 %)	1 (.017 %)	.218
≤18	618 (99.83 %)	619 (99.83 %)	
Gestational age	39.3 ± 9	38.3 ± 3	.001
Birth weight	3300 ± .43	3230 ± .47	.01
Apgar 1 min	8 ± .8	9.06 ± .4	.04
Apgar 5 min	9.86 ± .56	9.84 ± 1.1	.68

Table 2 Infection rates by MSAF

Amniotic fluid	Total deliveries	Endomyometritis	*P* value
Clear	620	1.5	.04
MSAF	619	3.2	

Table 3 Comparison of MSAF as a predictor of perinatal outcome

Outcome	Odds ratio	95 % CI
Endomyometritis[a]	1.52	1.20–1.94
One-min Apgar score, <7[a]	2.20	1.70–2.82

[a] Controlled for maternal age, parity, education, ethnicity, length of labor, and birth weight

In the multivariate model (Table 3), with the use of the MSAF as a predictor for puerperal infection, we found that MSAF was significantly associated with increases in endomyometritis (odds ratio 1.52; 95 % CI 1.20–1.94) and 1-min Apgar score of <7 (odds ratio 2.20; 95 % CI 1.70–2.82). In this model, we controlled for maternal age, parity (young maternal age and nulliparity), level of education, gestational age, birth weight, and length of labor.

Discussion

The present study reports the results of a cohort study of MSAF and puerperal infection in Kosar Hospital, Qazvin, Iran. We found that the presence of meconium staining was

associated with endomyometritis. This association was robust even when controlled for multiple confounding factors that included length of labor, gestational age, parity, birth weight, duration of rupture of membrane, and mode of delivery. However, previous studies reported that an association between MSAF and infection existed. Jazayeri et al. [17] showed that the MSAF is associated with increased endometritis, Piper et al. [18] reported that the MSAF is associated with increased peripartum infection, and Tran et al. [8] concluded that chorioamnionitis and endomyometritis are associated with MSAF. But Boonprasert et al. [3] and Mostaghel et al. [19] found no relationship between MSAF and endomyometritis. It seems that such conflicting results about the relationship between the MSAF and endomyometritis are due to the differences between selected variables, the conditions of the studies and the sample size, prophylactic antibiotic given before, during, and after delivery, and kind of delivery which may affect the results. The present study was controlled by multiple confounding factors such as route of delivery, length of labor, prior antibiotic prophylaxis, and duration of rupture of membrane in Kosar Hospital.

In the current study, a relationship was found between gestational age and birth weight with MSAF. Balchin et al. [20] showed that the MSAF is associated with gestational age as well. Sedaghatian et al. [21] reported that birth weight is associated with MSAF. It seems that with increased gestational age and birth weight, the risk of MSAF is also increased.

The adverse neonatal outcomes associated with MSAF were observed in our study with 1- and 5-min Apgar scores <7. The present study reports reduction 1-min Apgar scores in MSAF. Meconium may decrease the neonate's ability to breathe on its own, particularly if MAS develops. Several studies investigate the relationship between low Apgar score and increased neonatal mortality with MSAF [22–24].

A Cochrane systematic review of 19 trials [25], most of which took place in developed countries, has concluded that a policy of routine induction of labor at 41 weeks of gestation reduced the risk of perinatal mortality (RR .30, 95 % CI .09–.99) and MAS (RR .29, 95 % CI .12–.68) without increasing the risk of operation. In another study, Susan et al. [8] estimated the risk of chorioamnionitis in MSAF (odds ratio 1.39, 95 % CI 1.20–1.61) and endomyometritis (odds ratio 1.51, 95 % CI 1.19–1.93). Consideration should be given to increased monitoring, or labor induction, earlier than 41 weeks of gestation.

Conclusion

According to the results of the present study, we found that the presence and severity of MSAF are associated with puerperal infection even when being controlled for confounders. It seems that accurate care to prevent infection is essential in cases of meconium passage.

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Compliance with Ethical Standards

Conflict of interest The research proposal of this study has been reviewed by the Medical Research Ethical Committee of the Qazvin University of Medical Science, and there is no conflict with ethical consideration date: January 15, 2012. The authors of this paper have not declared any conflicts of interest.

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